

Simultaneous inferior and middle meatus antrostomies in the treatment of the severely diseased maxillary sinus

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ABSTRACT

Background: Although the majority of the maxillary pathology can be eradicated through the enlarged middle meatus antrostomy (MMA), some patients have extensive disease that is difficult to cope with. The aim of this study was to estimate the usefulness of simultaneous middle and inferior meatal antrostomies (MIMAs) in cases with severely diseased maxillary sinus by comparing the subjective and objective outcomes between patients that underwent MIMA and those who experienced maxillary clearance through conventional MMA.

Methods: A prospective study was performed on patients with nasal polyps and severely diseased maxillary sinus (Lund-Mackay CT score = 2). All diseased sinuses were addressed with the same endoscopic sinus surgery technique; the only difference consisted of the management of the maxillary sinus: 34 patients underwent MIMAs and in 38 cases maxillary sinus was approached solely through the MMA. After 12 months of follow-up, outcomes consisted of the visual analog scale (VAS) for the main symptoms, the Lund-Mackay and maxillary sinus endoscopic scores, and the percent of airspace occluded by inflammatory mucosal thickening on CT.

Results: Subjective improvement in VAS scores for nasal obstruction, facial pain, and nasal discharge/retronasal drip was significantly better in the MIMA group. The mucosal thickening as expressed by the CT scan and maxillary endoscopic score was significantly reduced in the MIMA group.

Conclusion: The MIMA technique is useful for removing severe disease that can not be reached through the MMA and yields both better subjective and better objective outcomes. The additional inferior antrostomy most likely improves drainage and ventilation in the postoperative period.

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Many studies have established the clinical effectiveness of endoscopic sinus surgery (ESS) in patients with chronic rhinosinusitis (CRS) after failed medical therapy.^{1–4} The basic tenets of ESS are opening and widening the obstructed sinus ostium, removing the irreversible damaged mucosa, and restoration of sinus drainage and ventilation.^{1–4} Although the majority of maxillary sinus pathology can be removed through the middle meatus antrostomy (MMA), extensive mucosal disease can be difficult to handle, especially in the anterior and inferior regions.^{5,6} In such conditions, occasionally the traditional Caldwell-Luc operation was elected. However, the Caldwell-Luc approach is associated with significant morbidity.⁷ To solve this problem, canine fossa puncture (CFP) has been proposed as an alternative method of obtaining access to the maxillary sinus.^{5,8,9} Although recent studies have shown the efficacy of CFP in the treatment of a severely diseased maxillary sinus,^{5,10} this view has been questioned.⁶ Another approach to visualize the hidden areas of the antrum is the inferior meatus antrostomy.⁸ Therefore, in patients with extensive mucosal disease of the maxillary sinus, the middle and inferior meatus antrostomies (MIMAs) could be performed simultaneously, aiming to expand surgical access and, concurrently, to improve the drainage and the ventilation of the diseased sinus during the recovery phase. This study was performed to estimate the usefulness of simultaneous MIMAs by comparing the subjective and objective outcomes between patients with severely diseased maxillary sinus who underwent MIMAs and those who experienced maxillary clearance through conventional MMA.

MATERIALS AND METHODS

This study (approved by the Institutional Review Board of the University of Medicine and Pharmacy Cluj-Napoca, in accordance with the Guidelines for Protection of Human Subjects) was conducted in a prospective manner. Patients were all informed and they con-

sented to participate in the study. All consecutive patients operated on between January 2005 and May 2009 for CRS with nasal polyps and extensive bilateral maxillary disease (total opacification on the CT scan) were included. Diagnosis of CRS was established according to the criteria set forth by the 2004 Rhinosinusitis Initiative¹¹: a strong history that includes the presence of typical symptoms lasting longer than 12 weeks despite maximal medical therapy and opacification of the sinuses on the CT scan. Excluded from the investigation were patients with a Lund-McKay score of <2; patients presenting maxillary sinuses filled with mucopus with normal-appearing mucosa; patients with unilateral maxillary sinus disease, fungal sinusitis, benign, or malignant tumors; patients suffering from immunodeficiencies, cystic fibrosis, or ciliary abnormalities; and patients with prior sinonasal surgery or facial trauma. Patients included in the study were randomly allocated into two groups: one group included patients who underwent MIMAs as part of the surgical procedure and the other group included patients whose maxillary sinuses were approached by means of MMA. Randomization was performed according to the randomization list, which was constructed using a statistical random number table.

Before surgery all patients completed a questionnaire including factors endorsed by the Rhinosinusitis Initiative¹¹: seven symptoms (nasal blockage, headache, facial pain, altered sense of smell, nasal discharge, retronasal drip, and cough) and global evaluations were assessed. For the purpose of this study we were interested only in facial pressure in the midface region and corresponding to the surface area overlying the maxillary sinus. Symptoms were graded using a visual analog scale (VAS), where “0” means absence of the symptoms and “10” means maximum severity. The questionnaire also recorded a detailed medical history (presence of allergy, asthma, and aspirin intolerance).

Each patient had preoperative sinus CT scan scored according to the radiological grading system proposed by Lund and McKay.¹² The Lund score was determined for all sinuses and for the maxillary sinus separately. A grading system was used for polyps within each nasal cavity: grade 1, polyps restricted to the middle meatus; grade 2, polyps that protrude below the middle meatus; and grade 3, polyps extending to the floor of the nose or massive diffuse polyposis. Each nasal cavity was scored separately and the average value was calculated.

All surgical procedures were performed by the same surgeon (S.A.) using the anterior to posterior approach and the extent of surgery was

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Table 1 Baseline characteristics, comparing middle and inferior meatus antrostomies (MIMA) and middle meatus antrostomy (MMA) groups

	MIMA Group (n = 48)	MMA Group (n = 48)	Statistics	p Value
Age, mean $\pm$ SD	45.3 $\pm$ 17.5	48.2 $\pm$ 18.3	Student's <i>t</i> -test	0.78
Gender, males/females	29/19	25/23	χ^2 -test	0.41
Polyp grade, mean $\pm$ SD	2.2 $\pm$ 0.5	2.4 $\pm$ 0.35	Student's <i>t</i> -test	0.25
CT score, mean $\pm$ SD	18.62 $\pm$ 3.72	19.45 $\pm$ 3.25	Student's <i>t</i> -test	0.35
Maxillary sinus endoscopic score, mean $\pm$ SD	3.40 $\pm$ 0.65	3.60 $\pm$ 0.35	Student's <i>t</i> -test	0.07
Surgical score, mean $\pm$ SD	10.5 $\pm$ 3.25	11.65 $\pm$ 2.7	Student's <i>t</i> -test	0.07
Allergy, n (%)	22 (46%)	19 (40%)	χ^2 -test	0.53
Asthma, n (%)	27 (55%)	29 (60%)	χ^2 -test	0.67
Aspirin intolerance, n (%)	10 (21%)	8 (16%)	χ^2 -test	0.6

determined according to the disease present on CT scan. Septoplasty was combined with ESS when indicated. In both groups the diseased sinuses were handled in the same manner, the only difference consisted of the management of the maxillary sinus. In the MIMA group, first, a large MMA was performed. Removal of the pathological contents and granulations from the maxillary sinus was performed under the guidance of the angled 45 and 70° endoscopes. Only true polyps and cysts were detached; excessive stripping of all mucosa was avoided to avoid exposing of underlying bone. To improve debridement of the maxillary sinus, an inferior meatus antrostomy was then performed following the previously published guidelines.¹³ No part of the inferior turbinate was removed during the procedure. In the other group only a large MMA was performed and the maxillary sinus was cleared as far as possible through the antrostomy. The microdebrider was never used and various curved forceps and suction tips were used to remove the pathological contents within the sinus.

In the course of ESS a score was ascribed according to the surgery score proposed by Lund and Kennedy.¹⁴ The endoscopic appearance of the maxillary mucosa was recorded according to Terrier's classification¹⁵: 0, normal mucosa, transparent, and nonproductive; 1, normoplastic and nonproductive with localized inflammatory signs (hyperemic or edema and isolated polyps); 2, normoplastic and productive (mucopurulent or purulent exudates); 3, hyperplastic mucosa (flat, polypoid, or with confluent polyps); 4, hyperplastic and productive mucosa.

The nasal pack was removed on the 2nd postoperative day and the patient was discharged. None of the patients were on oral corticoids preoperatively; nevertheless, in the postoperative period all patients were prescribed a tapering course of oral prednisolone (20 mg). Nasal topical steroids and saline irrigation were also recommended for 6 weeks.

Postoperative controls were scheduled every 3 months after surgery. At each visit we documented the number of attending patients and the same VAS questionnaire was applied. To reduce the number of cases lost to follow-up, the authors contacted the patients with missed appointments to arrange alternative clinical visits. During the same follow-up visit antibiotics and oral steroids were prescribed for 10 days if the patient had inflammatory signs or polypoid appearance of the maxillary sinus mucosa (10 days of medication = 1 course of treatment). In addition, nasal topical corticosteroids were also prescribed for another 6 weeks. The follow-up examination and medical prescriptions were performed by two doctors (A.G. and S.N.) who were blinded to the surgical technique. To ascertain the reasons for dropout, missing patients were called and a telephone interview was conducted.

The patients were recalled for CT assessment, endoscopic examination, and interview concerning symptoms 12 months after surgery. The same VAS questionnaire and Terrier's endoscopic scoring system were used during final evaluation. The Lund-MacKay score was

computed for all sinuses and for the maxillary sinus separately. The Lund-MacKay score was calculated separately by two doctors (A.G. and S.N.) who were blinded to the surgical technique and the average score was used for analysis. In addition, the percentage of mucosal thickening of the maxillary sinus was determined according to the method recommended by Ponikau *et al.*^{16,17} First, the posttreatment CT scans were digitized (Photoshop 6.0; Adobe Systems, Inc., San Jose, CA). To standardize the comparison of the CT scans, the image plane showing the ostium of the maxillary sinus supported by distinctive bony landmarks was selected. The graphics program converted the area of inflammatory mucosal thickening, which is represented with a specific grayscale value on the CT scan, into a number of pixels. Thus, the extent of mucosal thickening could be compared.

A sample size of 66 patients was calculated using the Wilcoxon two-sample test, two sided, at 5% level of significance to give the study a statistical power of 80%. The primary end point was determined to be a 1-point difference on the Terrier's classification of the maxillary sinus mucosa appearance. Terrier's score is an objective outcome measure previously validated by our group in another study.¹⁸ To compensate for the dropouts and to increase the power, the number of patients to be included was raised to 96 cases. Statistical analysis was performed using SPSS Version 10.0 (SPSS, Inc., Chicago, IL). Data were expressed as mean $\pm$ SD. Values of $p < 0.05$ were considered significant. Parametric tests, such as the two-sample *t*-test and analysis of variance, were applied for data that followed or were transformed to a normal distribution. Nonparametric tests, such as Mann-Whitney *U* test and χ^2 -square test were applied for data that did not follow a normal distribution.

RESULTS

Forty-eight patients in each treatment arm fulfilled the inclusion criteria of the study. At 3 months all patients were available for follow-up; however, there is a gradual decrease in patients attending control visits at 6, 9, and 12 months. At the end of the study, 34 patients from group A and 38 patients from group B completed the 12-month follow-up period and were available for the subjective and objective evaluation. The rest of the patients dropped out of the study during the follow-up. Table 1 summarizes the patient demographics at enrollment in the study. As one can see, there are no statistically significant differences between the two groups concerning the baseline parameters (age, gender, CT and surgical scores, polyp grade, endoscopic Terrier score of the maxillary sinus, percent of cases with asthma, allergy, and aspirin intolerance).

Table 2 presents postoperative VAS symptom scores documented at each visit in the two treatment groups. The number of patients attending their follow-up visit every 3 months for the 12-month follow-up is also listed. The preoperative VAS of each symptom improved significantly at 3, 6, 9, and 12 months postoperatively in both groups. The overall VAS score was less in MIMA patients at every follow-up visit. Additionally,

Table 2 Visual analog scale results for the two patient groups during the follow-up period

	MIMA Group (mean $\pm$ SD)	<i>n</i>	MMA Group (mean $\pm$ SD)	<i>n</i>	<i>p</i> Value
Nasal obstruction					
Preoperative	7.75 $\pm$ 2.10	48	8.10 $\pm$ 1.75	48	0.46*
At 3 mo	1.65 $\pm$ 2.22	48	2.77 $\pm$ 2.25	48	0.008#
At 6 mo	1.75 $\pm$ 2.01	40	2.90 $\pm$ 2.05	42	0.009#
At 9 mo	1.80 $\pm$ 2.55	36	2.88 $\pm$ 2.39	39	0.01#
At 12 mo	1.91 $\pm$ 1.65	34	2.93 $\pm$ 2.19	38	0.03#
Nasal discharge					
Preoperative	6.54 $\pm$ 1.95	48	7.05 $\pm$ 2.30	48	0.26*
At 3 mo	1.95 $\pm$ 2.25	48	3.70 $\pm$ 2.85	48	0.007#
At 6 mo	2.35 $\pm$ 2.45	40	3.95 $\pm$ 3.24	42	0.009#
At 9 mo	2.66 $\pm$ 2.75	36	4.15 $\pm$ 2.95	39	0.01#
At 12 mo	2.94 $\pm$ 1.74	34	4.32 $\pm$ 2.82	38	0.02#
Postnasal drip					
Preoperative	4.88 $\pm$ 2.65	48	5.15 $\pm$ 2.45	48	0.64*
At 3 mo	2.15 $\pm$ 2.09	48	3.55 $\pm$ 2.50	48	0.01#
At 6 mo	2.20 $\pm$ 2.85	40	3.82 $\pm$ 2.66	42	0.02#
At 9 mo	2.55 $\pm$ 2.66	36	3.75 $\pm$ 2.73	39	0.01#
At 12 mo	2.38 $\pm$ 2.20	34	3.62 $\pm$ 2.89	38	0.02#
Headache					
Preoperative	3.65 $\pm$ 1.88	48	3.92 $\pm$ 1.50	48	0.42*
At 3 mo	1.85 $\pm$ 2.10	48	2.10 $\pm$ 2.33	48	0.09#
At 6 mo	2.02 $\pm$ 2.15	40	2.44 $\pm$ 2.52	42	0.73#
At 9 mo	1.97 $\pm$ 1.79	36	2.05 $\pm$ 2.42	39	0.62#
At 12 mo	2.05 $\pm$ 1.88	34	2.45 $\pm$ 1.93	38	0.27#
Facial pressure					
Preoperative	4.40 $\pm$ 1.90	48	4.10 $\pm$ 2.17	48	0.5*
At 3 mo	2.02 $\pm$ 2.56	48	3.56 $\pm$ 2.28	48	0.01#
At 6 mo	1.88 $\pm$ 2.48	40	3.40 $\pm$ 2.96	42	0.008#
At 9 mo	1.97 $\pm$ 2.35	36	3.15 $\pm$ 2.77	39	0.009#
At 12 mo	2.10 $\pm$ 1.74	34	3.25 $\pm$ 2.21	38	0.01#
Smell changes					
Preoperative	6.88 $\pm$ 2.44	48	7.35 $\pm$ 3.85	48	0.47*
At 3 mo	2.75 $\pm$ 2.23	48	2.66 $\pm$ 2.44	48	0.25#
At 6 mo	3.83 $\pm$ 2.72	40	3.72 $\pm$ 2.98	42	0.45#
At 9 mo	4.42 $\pm$ 3.10	36	4.55 $\pm$ 2.78	39	0.68#
At 12 mo	4.74 $\pm$ 3.62	34	4.35 $\pm$ 3.77	38	0.72#
Cough					
Preoperative	3.35 $\pm$ 1.12	48	3.21 $\pm$ 1.78	48	0.63*
At 3 mo	1.70 $\pm$ 2.21	48	1.56 $\pm$ 1.87	48	0.52#
At 6 mo	1.58 $\pm$ 1.96	40	1.73 $\pm$ 1.62	42	0.41#
At 9 mo	1.62 $\pm$ 1.74	36	1.82 $\pm$ 1.75	39	0.52#
At 12 mo	1.65 $\pm$ 1.75	34	1.91 $\pm$ 1.84	38	0.72#
Overall					
Preoperative	6.65 $\pm$ 2.70	48	7.33 $\pm$ 2.45	48	0.19*
At 3 mo	2.65 $\pm$ 1.92	48	3.77 $\pm$ 2.65	48	0.007#
At 6 mo	2.50 $\pm$ 1.88	40	3.55 $\pm$ 2.78	42	0.01#
At 9 mo	2.20 $\pm$ 2.10	36	3.68 $\pm$ 2.89	39	0.009#
At 12 mo	2.43 $\pm$ 2.21	34	3.85 $\pm$ 2.46	38	0.02#

*Student's *t*-test.#Mann-Whitney *U* test.

MIMA = middle and inferior meatus antrostomies; MMA = middle meatus antrostomy.

a statistical significant difference was found for nasal obstruction, facial pressure, nasal discharge, and postnasal drip, indicating better symptom control in MIMA cases. This symptomatic difference retains its statistical significance throughout the whole follow-up. However, there were no significant differences in the other symptoms between the two groups. Patients who did not attend the follow-up visit were those satisfied with their symptomatic improvement and thus were no longer motivated to seek further medical attention.

Inflammatory mucosal thickening as expressed by CT and endoscopy is presented in Table 3. Mean maxillary postoperative Lund-

Mackay score was significantly lower in group A. The percent of airspace occluded by inflammatory maxillary mucosal thickening on CT scan was significantly inferior in MIMA patients. This difference between the two groups is reflected in the maxillary sinus endoscopic findings. The maxillary endoscopic findings and CT grading showed good correlation (Sperman's ρ , 0.7; $p < 0.0001$).

Given that ~30% of the enrolled patients in the experimental arm were lost to follow-up, an intention-to-treat analysis was performed and the results were compared with the per protocol analysis. For that purpose, patients were classified in those with major and minor symp-

Table 3 Inflammatory maxillary sinus mucosal thickening as expressed by postoperative CT and endoscopy scores

	MIMA Group (n = 34)	MMA Group (n = 38)	Statistics	p Value
Lund-Mackay score	0.78 ± 0.87	1.25 ± 0.89	Mann-Whitney U test	0.002
Percent of airspace occluded by inflammatory mucosal thickening	21.45 ± 10.84	31.81 ± 12.35	Mann-Whitney U test	0.0001
Maxillary sinus endoscopic score	1.55 ± 1.44	2.28 ± 1.89	Mann-Whitney U test	0.001

MIMA = middle and inferior meatus antrostomies; MMA = middle meatus antrostomy.

Table 4 Symptomatic improvement in the two treatment groups at the end of the follow-up: Per protocol analysis

Symptom	Group	Major Improvement	Minor Improvement	p Value (χ^2 -test)
Nasal obstruction	MIMA	32	2	0.001
	MMA	24	14	
Nasal discharge	MIMA	28	6	0.01
	MMA	21	17	
Postnasal drip	MIMA	27	7	0.03
	MMA	21	17	
Headache	MIMA	28	6	0.2
	MMA	27	21	
Facial pressure	MIMA	29	5	0.03
	MMA	24	14	
Smell changes	MIMA	17	17	0.5
	MMA	16	22	
Cough	MIMA	30	4	0.6
	MMA	32	6	
Overall	MIMA	29	5	0.02
	MMA	23	15	

Major improvement, VAS score <3.

Minor improvement, VAS score >3.

MIMA = middle and inferior meatus antrostomies (34 patients); MMA = middle meatus antrostomy (38 patients); VAS = visual analog scale.

Table 5 Symptomatic improvement in the two treatment groups at the end of the follow-up: Intention-to-treat analysis

Symptom	Group	Major Improvement	Minor Improvement	p Value (χ^2 -test)
Nasal obstruction	MIMA	41	7	0.02
	MMA	32	16	
Nasal discharge	MIMA	38	10	0.04
	MMA	29	19	
Postnasal drip	MIMA	38	10	0.04
	MMA	29	19	
Headache	MIMA	36	12	0.3
	MMA	32	16	
Facial pressure	MIMA	40	8	0.02
	MMA	30	18	
Smell changes	MIMA	27	21	0.5
	MMA	23	25	
Cough	MIMA	40	8	0.6
	MMA	38	10	
Overall	MIMA	40	8	0.02
	MMA	30	18	

Major improvement, VAS score <3.

Minor improvement, VAS score >3.

MIMA = middle and inferior meatus antrostomies (48 patients); MMA = middle meatus antrostomy (48 patients); VAS = visual analog scale.

tomatic improvement: if VAS at the last follow-up was <3 it was counted as a major improvement. During the telephone interview missing patients were asked to rate their symptoms as major or minor improvement. There were three patients in the MIMA group and four patients in the MMA group who were definitely lost to follow-up. These patients were counted as minor improvements in the intention-to-treat analysis. The results of these two analyses are listed in Tables 4 and 5, respectively. On examination of these tables, one can conclude that the

two analyses yield similar results: a significant improvement for nasal obstruction, discharge, postnasal drip, facial pressure, and overall symptoms for the MIMA group.

Medication use during the follow-up period was significantly different among the two groups: 5 courses of treatment in MIMA group versus 14 courses in the MMA group ($p = 0.03$, chi-square test). During the 12-month period there were no patients who required two or more "rescue" treatments. No treatments were provided through

the inferior meatus window in the MIMA group during the follow-up period.

The MIMA technique carries the risk of potential complications such as epiphora.¹³ During the follow-up, there were no postoperative bleedings or epiphora recorded. No cases of floppy inferior turbinate were documented. None of the patients in the two groups complained of newly developed symptoms related to the surgical procedure.

DISCUSSION

Patients undergoing MIMAs showed statistically less symptoms (nasal obstruction, facial pressure, nasal discharge, and retronasal drip) and less mucosal thickening on postoperative CT scan and maxillary endoscopy. Because intention-to-treat and per protocol analyses yield similar conclusions, we can assume that the statistical difference encountered in our study holds true. We have enrolled a great number of patients in both treatment arms to compensate for the phenomenon of selective attrition. This describes the tendency for longitudinal studies to experience bias at longer follow-up as patients with better outcomes may become less likely to continue to seek care.

Significantly better outcomes in MIMA patients are presumably because of better clearance of the disease and to improved drainage and ventilation through the two anastomoses. It has been suggested that incomplete clearance of the maxillary sinus generates ongoing inflammation, a process likely to delay mucosal healing and connected with recurrent disease.^{5,19} The scores for nasal obstruction and facial pressure may not be related to the maxillary sinus disease itself; they are related also to the existence of nasal polyps, septum deviation, and inferior turbinate hypertrophy.^{5,6} However, burden of disease, polyp score, and number of septum surgeries were not different between the two groups. The better outcome for obstruction in the MIMA group might be caused by the fracture of the inferior turbinate, a method known to induce shrinkage of the turbinate.

According to Hosemann *et al.*²⁰ there are limitations to be faced during routine ESS on the maxillary sinus. If a generous MMA is provided, one can control most areas of the antrum. Nevertheless, not even after a maximum MMA do angled endoscopes and instruments allow precise management of the entire maxillary sinus, especially in the areas of the alveolar recess, the anterior and medial walls. These authors as well as others suggest that an additional inferior anastomosis may help out.^{8,9,20}

Mucociliary clearance in the maxillary sinus may be impaired by longstanding inflammation, scarring, immunodeficiency, resistant organisms, or maxillary osteitis.²¹ During the postoperative period the ensuing scar tissue formation and regrowth of mucosa with poorly ciliated epithelium may result in altered maxillary clearance. Besides, many patients with extensive maxillary disease have associated inflammatory respiratory diseases. Then again, inflammation is acknowledged to significantly slow down the mucociliary clearance.^{3,13} As a result, maxillary sinus drainage and ventilation through the MMA may not function. It was previously indicated that maxillary sinuses that appear to be terminally diseased may be rehabilitated surgically without the need for surgical stripping.²¹ Endoscopic maxillary mega-anastomosis is another mucosal sparing technique accredited to facilitate mucus clearance and sinus irrigation in terminally dysfunctional maxillary sinuses.²¹ The MIMA approach is used on the assumption that mucociliary clearance can not be completely restored after a conventional MMA in patients with extensive maxillary disease. Through the double anastomoses we aim to achieve maximum aeration of the sinus, a minimization of the risk of mucus entrapment, as well as a facilitation of removal of mucus and small crusts by the patient. In addition, because the bone itself might be a source of chronic inflammation, as suggested by Kennedy *et al.*,²² the removal of the bone from the inferior meatus might reduce the incentive for persistent chronic inflammation of the overlying mucosa.

Ochi *et al.*¹³ showed, by use of the India ink test, a postoperative discharge through the inferior anastomosis in those patients pre-

sented with severely diseased maxillary sinus mucosa. However, this flow was absent in cases with moderate disease. All patients exhibited a discharge through the MMA and no circular flow was documented.¹³

The advantage of simultaneous inferior meatal anastomosis is that it provides both intra- and postoperative benefits.¹³ It is not necessary to make a new mucosal incision at the canine fossa and avoids the inherent side effects of CFP.^{5,8,9} When viewed in combination, these two windows provide a perspective that is greatly superior to that obtained from one window alone. Moreover, a previous article suggested that it may have some protective effect against recurrence.¹³ An additional advantage is that in cases where further postoperative treatments are needed, instruments and topical corticoids are easily introduced through the inferior meatal window.^{13,22,23} It has been claimed that exposure to the open air might contribute to the improvement of mucociliary function.¹³

Previous studies showing inappropriate mucosal clearance and circular flow with the presence of an inferior meatal maxillary anastomosis did not address diseased mucosa from a persistent inflammatory state.^{3,24} Our results support the previous articles indicating that CFP is associated with better outcomes and less mucosal thickening.^{5,10} Nonetheless, Lee *et al.*⁶ disagree with these conclusions. According to Wormald *et al.*,¹⁰ this discrepancy might be explained by differences between the study groups in the extent of nasal polyps and disease burden as assessed by Lund-Mackay scores, inclusion of fungal sinusitis and revision surgery in the Australian cohorts, and significant differences in eosinophilia of nasal polyps in Asia versus western countries. Moreover, Lee *et al.*⁶ excluded patients with allergies, asthma, or aspirin intolerance and no mention is made on the power of their study.

We tried to preserve the entire turbinate, allowing for humidification, filtration, and heating of the inspired air. Although Wormald *et al.*^{8,9} cautioned against the destabilization of the inferior turbinate during MIMAs, no such complications were encountered.

At the end of the follow-up all of our MIMA patients presented with a patent inferior anastomosis. Lund²⁵ stated that 53% of inferior meatal anastomoses were closed with a mean follow-up time of 26 months. However, their data would not hold true for our patients because their surgical procedures and anastomosis sizes were different. Lund²⁵ also reported that if a hole of adequate size (2×1 cm) is made, it tends to remain open, although this does not necessarily protect the patient from further problems. In the same article it is suggested that if the intranasal anastomosis is patent at 1 year, it will remain patent thereafter. These ideas are consistent with our present results. Long-term follow-up in a larger number of patients is necessary to validate this issue. Although our present results indicate that the existence of the inferior meatus window is useful for the intraoperative procedure and postoperative follow-up, the short follow-up period indicates that additional study is necessary.

CONCLUSION

This study has shown that the MIMA technique is a useful method for removing severe mucosal disease within the maxillary sinus that can not be reached through the MMA and it yields both better subjective and better objective surgical outcomes. The additional inferior anastomosis most likely improves drainage and ventilation in the postoperative period and decreases ongoing inflammation.

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